

# Cryptosporidiosis Outbreak in a Nassau County, Florida, Return Travel Group from Ireland, May 24, 2006–June 4, 2006

Rebecca Lazensky, M.P.H.  
 Roberta M. Hammond, Ph.D., R.S.  
 Kathleen Van Zile, M.S.E.H., R.S.  
 Kim Geib, M.S.N., A.R.N.P.

## Abstract

The Nassau County Health Department (NCHD) in Florida investigated an outbreak of gastrointestinal (GI) illness in a returning choral group who toured Ireland from May 24 to June 4, 2006. The travel group, consisting predominantly of retirees, had performed at several churches and at a dinner theater in Ireland. The NCHD administered a telephone questionnaire to 40 of the 41 group members to examine possible water exposures; common meals; and food, travel, and clinical histories. The results of the questionnaire showed that 29 people met the case definition for the outbreak. Five stool samples from travel group members tested positive for *Cryptosporidium parvum*, a species that is animal in origin and often spread through an environmental contamination with animal feces. All five positive samples were subtyped IlaA16GIR1b, a strain that scientists at the Centers for Disease Control and Prevention (CDC) Division of Parasitic Diseases detected twice in 2006 in other human specimens from Northern Ireland.

## Introduction

The Nassau County Health Department (NCHD) received a call on June 8, 2006, from a physician who had accompanied a local choral group to Ireland from May 24 to June 4, 2006. The physician reported gastrointestinal (GI) illness in approximately 19 of the 41 travelers with an onset period of 0–3 days after returning to Florida on June 4. According to the physician, the predominant symptoms reported were diarrhea, abdominal cramping, vomiting, and low-grade fever. The physician's chief concern was the unsanitary conditions on the travel group's return transatlantic flight. Travel group members reported unsanitary plane conditions, such as

long lines to the bathroom (15 people long), debris and toilet paper in the aisles, clogged toilets, overflowing sinks, and wet floors and toilet seats. The initial survey information, an apparent incubation time similar to norovirus, and the travelers' symptoms suggested a norovirus-like illness.

## Methods

### Epidemiology Investigation

On June 9, 2006, NCHD began administering a telephone questionnaire designed to examine possible water exposures; common meals; and food, travel, and clinical histories. A "confirmed" case was defined as an indi-

vidual who traveled with the group in Ireland and was laboratory confirmed for *Cryptosporidium parvum* with onset of severe diarrhea (three or more loose stools in a 24-hour period) between May 25 and June 16, 2006, or two or more of the following symptoms: vomiting, nausea, bloating, cramps, abdominal pain, myalgia, fever ( $\geq 100^{\circ}\text{F}$ ), and chills. A "probable" case was defined as an individual with symptoms compatible to a confirmed case who had traveled with the group to Ireland, and who was linked epidemiologically to a confirmed case.

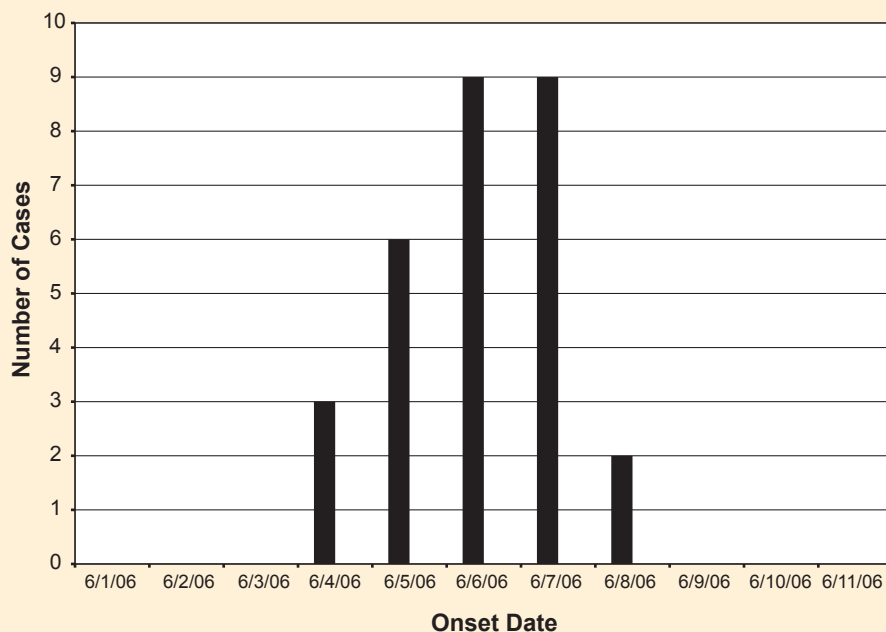
A total of 41 people attended the group trip, 40 of which were surveyed. Nine of the travel group members left the group early on June 4 to travel to other locations in Europe, but the majority of persons returned to the United States together on June 4 on the same flight. Travel group members who returned on the group flight on June 4 were classified as Group 1 (32 persons). Travel group members who stayed in Europe and did not return to the United States on June 4 were classified as Group 2 (9 persons). All persons in Group 1 were surveyed and eight of the nine persons in Group 2 were surveyed. Data were analyzed using Epi Info 2005 software (Centers for Disease Control and Prevention [CDC], 2005).

### Laboratory Investigation

Stool specimens from fourteen cases were sent to the Florida Department of Health Bureau of Laboratories in Jacksonville and cultured for *Salmonella*, *Shigella*, *Campylobacter*,

**TABLE 1****Symptoms Reported by Travel Group Members**

Symptoms	Percentage with Symptom	Average Duration of Symptom (Days)
Diarrhea	93.1	3.4
Bloating	84.6	3.3
Gas	78.6	3
Body aches	55.2	3.2
Nausea	53.6	2.9
Headache	53.3	3.2
Cramps	51.7	3.4
Abdominal pain	48.3	3.3
Chills	25.9	2.5
Fever	14.3	2
Vomiting	13.8	1.3

**FIGURE 1****Onset Dates of Cases in *Cryptosporidium* Outbreak in Return III Travelers (Group 1 and 2)**

and *Escherichia coli* O157:H7; all were negative. Six of the 14 specimens were tested using viral real-time reverse transcription-polymerase chain reaction (RT-PCR) tests to detect type G1 or G2 norovirus. All six specimens tested negative for norovirus. Fourteen specimens were tested using acid-fast staining for ova and parasites. Five stool samples tested positive for *Cryptosporidium* and were sent to the Centers for Disease Control and

Prevention (CDC) Division of Parasitic Diseases in Atlanta, Georgia, for PCR speciation and genotype testing.

## Results

### Epidemiology Investigation

The mean age of the travel group members was 64.8 years (range: 23–79 years). All 40 were non-Hispanic Caucasians. Twenty-five

(62.5%) were female, 15 (37.5%) were male. Twenty-nine of the 41 travel group members met the case definition for the outbreak. Twenty-four members of Group 1 and five of the eight people surveyed in Group 2 met the case definition for GI illness. The attack rate (AR) in Group 1 was 75% compared to 62.5% in Group 2. The similar attack rates in the two groups supports the hypothesis that the group exposure did not occur on the return flight on June 4.

The following symptoms were reported in the 29 travel group members who met the case definition for the outbreak: diarrhea (27 [93.1%]), bloating (11 [84.6%]), gas (11 [78.6%]), body aches (16 [55.2%]), nausea (15 [53.6%]), headache (16 [53.3%]), cramps (15 [51.7%]), abdominal pain (14 [48.3%]), chills (7 [25.9%]), fever (4 [14.3%]), and vomiting (4 [13.8%]). Of the 27 persons who reported diarrhea, their symptoms included bloody stools (2 [12.5%]), mucous in stools (4 [25.0%]), and watery stools (24 [96.0%]), with a mean of 6.7 loose stools in a 24-hour period (Table 1).

The mean duration of illness was 4.6 days. Cases reported a mean of 4.5 symptoms. Nine persons (31%) reported an illness lasting one to three days, 16 (55.1%) reported four to six days, and four (13.7%) reported seven or more days. Illness onset dates ranged from June 4 to June 8, 2006. The epidemic curve is consistent with a point-source outbreak (Figure 1).

Travel group members were surveyed concerning their recreational water exposure since cryptosporidiosis cases are commonly associated with treated water sources given the parasite's resistance to chlorine, high infectivity, and filtration challenges because of its relatively small size (CDC, 2007). Eight travel group members reported recreational water exposure within 30 days prior to the first onset of illness on June 4. None of the travelers lived in an assisted living facility, visited a daycare center, or worked in the food service industry 30 days prior to the first case of illness.

The group's travel history included choral performances at several churches and a dinner theater restaurant throughout Ireland from May 24 to June 4, 2006. Group members stayed at the same four hotels and had a group meal plan that included breakfast at the hotels and five group dinners. The group dinners were held at the four hotels and also at a dinner theater restaurant prior to their choral performance. The group dinners occurred on May 25, 27, 30, 31, and June 3,

2006. There were no other meals where more than 50% of the travel group members were present. Dining options were from a fixed menu in which the group had three choices for an appetizer, side dish, main course, and dessert. During each of the dinners, all group members were in attendance, with the exception of the June 3 meal, where one person (who subsequently developed GI illness) did not attend. No snacks or refreshments were served at the various locations where the travel group performed. Based on food and drink survey histories, the common meal on June 3 was eliminated as a source for the outbreak since no food or drink items proved to be epidemiologically significant (Table 2).

The NCHD was informed by the trip organizers that the travel group had exposure to water that may have come from a private well while at the dinner theater restaurant. This group meal occurred on May 31 at a 150-year-old establishment in rural Killarney, Ireland. Several of the travel group members reported that farm animals and horses were located on the premises. During the dinner, travelers had a choice of either water or an alcoholic beverage; soft drinks were not available. Many travelers chose to drink water since they were performing later that night.

The analysis of survey data showed a strong association between the consumption of drinking water at the dinner theater restaurant and developing GI illness. The dinner occurred seven days before the peak of the onset dates, which is consistent with the incubation period of *Cryptosporidium* (average incubation period: seven days; range: 1–12 days [Heymann, 2004]). The risk for the exposed group was 96.6% (95% CI [confidence interval] = 81.37, 100) and the risk for the unexposed was 16.7% (95% CI = 1.136, 58.22). The risk ratio was 5.79 (95% CI = .97, 34.71), suggesting that those who drank water at the dinner theater restaurant were 5.8 times more likely to develop illness than those who did not. The overall risk of drinking water and developing GI illness was 82.9% (95% CI = 66.94, 92.28).

### Laboratory Investigation

Five stool specimens tested positive for *C. parvum* and negative for *C. hominis* using DFA testing. The results from a Luminex post-hybridization test yielded five positive samples which were subtyped as IlaA16G1R1b, a strain that CDC's Division of Parasitic Diseases scientists detected twice in 2006 in other samples. In both cases, the IlaA16G1R1b

## TABLE 2

### Food and Beverage Items Consumed at June 3, 2006, Group Meal at Hotel

Food or Beverage Item	Risk Ratio	Confidence Interval	Attack Rate %
Alcoholic beverage	1.01	.69–1.48	71
Cauliflower and cheese	0.78	.52–1.17	63
Chicken with bacon	0.89	.56–1.40	67
Chicken without bacon	1.39	1.14–1.70	–
Chocolate mousse	0.79	.51–1.22	63
Coffee	1.18	.78–1.79	83
Cream of vegetable	1.1	.72–1.66	78
Fish sampler	0.96	.65–1.41	71
Fruit	0.44	.09–2.45	33
Ice	1.82	.86–3.84	81
Lamb	0.86	.58–1.28	67
Lemon wedge	0	0	–
Melon	1.31	.94–1.84	89
Mixed vegetable	1.19	.73–1.95	76
Orange wedge	0	0	–
Plum madeira	0.75	.39–1.47	57
Potato	1.39	.75–2.58	77
Salmon	1.18	.78–1.79	83
Soft drink	0	0	–
Tea	0.34	.03–3.77	–
Toffee panna cotta	1.4	.98–2.01	88
Water	1.84	.77–4.40	79

strain originated in human specimens from Northern Ireland. *C. parvum* species is animal in origin and can spread through an environmental contamination with animal feces (CDC, 2007).

### Discussion

At the onset of the investigation, the NCHD epidemiology team had based their primary suspicion of point-source exposure of norovirus on the reports of the unsanitary conditions on the airplane and the incubation time, which was compatible with norovirus. The primary suspicion changed when the NCHD received the initial positive *Cryptosporidium* antigen laboratory result. This result was from the physician who reported the outbreak and who had previously submitted a stool sample to his physician. Furthermore, additional reports of GI illness from travel group members who did not return home on the suspect transatlantic flight on June 4 had also been received. Due to the illness in this group and the reporting physician's positive *Cryptosporidium* antigen lab report, the pri-

mary focus of the focus of the investigation shifted from a possible norovirus outbreak on a plane to a point-source exposure to *Cryptosporidium* in Ireland.

In order to prevent additional cases of disease, the NCHD communicated their investigative findings with the CDC's Division of Parasitic Diseases and Division of Global Migration and Quarantine and the Health Protection Surveillance Center (HPSC) in Ireland. Prior to receiving the positive *Cryptosporidium* laboratory results, NCHD had consulted with CDC regarding follow-up procedures, such as aircraft quarantine and the public health inspections of facilities. CDC determined that the plane used by the returning Group 1 travelers did not need to be quarantined, since a norovirus outbreak had not occurred and survey data demonstrated no reports of diarrhea on the plane returning from Ireland to Philadelphia on June 4. CDC's Division of Parasitic Diseases recommended that NCHD communicate the findings of the epidemiological investigation with the overseeing authorities in Ireland.

## Environmental Health Investigation

Public health services in Ireland are managed by the Health Services Executive and divided into four administrative areas. Killarney is located in the South Health Services Executive Region (Citizens Information, 2007). Following the CDC's provision of a contact in Ireland, NCHD, with the state's Food and Waterborne Disease Coordinator, contacted the Health Protection Surveillance Centre (HPSC) in Dublin on June 20, who directed them to the HPSC in Cork, which oversees the Killarney area. NCHD provided HPSC in Ireland with the survey data and the group's travel history for future investigation. HPSC informed NCHD that there had not been an increase of *Cryptosporidium* cases in Ireland during 2006 nor had there been a rise in cases reported in tourists with recent travel to Ireland. Thus, according to the corresponding authorities in Ireland, this outbreak did not appear to be related to any other ongoing outbreak in Ireland at the time, and their review of the literature showed no major outbreaks since the three large-scale drinking-water-associated outbreaks in the Belfast area of Northern Ireland in 2000–2001 (Glaber-man et al., 2002).

The NCHD provided the HPSC with the names of the hotels, restaurants, and dinner theater where the group meals were consumed. HPSC reported that a local sanitation authority completed an inspection of dinner theater facilities and found that their water supply met the standards for potable water set by the European Union and enforced by Ireland's 34 local sanitation authorities. The HPSC sanitation inspector reported that the dinner theater had an approved public water system and that the dinner theater restaurant's proprietor had both a private well (reportedly used for personal needs only) and a publicly regulated water source (for restaurant operations). The inspector reported that the restaurant's proprietor stated that only the public water source was used for restaurant operations.

## Study Limitations

The chief limitation of this study was the lack of recall of travel group members, which obstructed the collection of food history data for all group meals and the ability to eliminate all potential exposures in Ireland. An attempt to gather additional exposure information through an expanded standardized questionnaire was hindered due to the time lapse before travel group members were re-surveyed

regarding their food and beverage consumption at the group meals. The epidemiological data obtained in the investigation, laboratory analysis, incubation periods, and exposure possibilities suggest that the infection was acquired in Ireland and that the drinking water exposure is a plausible hypothesis for the source of the infection. However, the exact source of the infection and the transmission mechanism cannot be confirmed. Further environmental health investigation of facilities within Ireland would be necessary to assess the sanitation levels and water quality at the various restaurant and hotels visited by the travel group. International outbreaks involving ill travelers who were out of the country during their incubation periods require a collaborative effort among public health authorities to oversee the public health investigation within their jurisdictions.

## Clinical Background

Cryptosporidiosis in humans is caused by fecal-oral ingestion of the *Cryptosporidium parvum*, a protozoan parasite that infects the epithelial cells of the human GI, respiratory, and biliary tract (Heymann, 2004). In adults the primary symptoms are watery diarrhea, cramping, abdominal pain, and to a lesser extent, fever, anorexia, malaise, fever, and vomiting; however, asymptomatic infections can occur (Heymann, 2004). Bloating, foul-smelling stools, and intermittent diarrhea also are commonly reported. Symptoms generally cease within one month, except in immunodeficient persons. Sources of past outbreaks have included recreational water parks, lakes, ponds, public and private water supplies, and contaminated beverages. The resistance of *Cryptosporidium* oocysts to chlorine and disinfectants leaves a variety of water sources vulnerable to contamination (Heymann, 2004).

*Cryptosporidium* oocysts can remain in the stool for several weeks after the symptomatic period, which generally lasts one to two weeks (Juranek, 1995). It is therefore recommended that infected individuals use sanitary precautions such as washing and disinfecting hands, bedding, sheets, towels, and common household areas. Symptomatic persons should avoid preparing food for others, visiting group settings such as daycare centers, assisted living facilities, and pools and recreational water parks for at least three weeks after their symptomatic period. Public health interventions during a *Cryptosporidium* outbreak provide an opportunity to limit further

transmission of the organism through education about healthy behaviors, inspecting contaminated facilities, and promoting public health partnerships.

## Incidence of Cryptosporidiosis in Ireland

Persons traveling to a country where they may be exposed to a new water source should consider drinking bottled, filtered water regardless of the country's status as a "developed" nation. The European Basic Surveillance Network (BSN) conducts communicable disease surveillance for European Union Member States and is comparable to the CDC. In 2005, the BSN reported that 16 European countries reported 7,960 cryptosporidiosis cases with a crude incidence rate of 1.9 cases per 100,000 persons. Ireland reported 265 cases of cryptosporidiosis in 2005 and had the highest incidence rate of 13.7 cases per 100,000 persons, followed by the United Kingdom with an incidence rate of 9.3 cases (Semenza & Nichols, 2007). Ireland experienced a large-scale outbreak of cryptosporidiosis in Galway from March 15 to August 23, 2007, originating from the public water supply. During this time period, 90,000 people in County Galway were under a boil water notice. From January 1 to August 20, 2007, 242 confirmed cases were reported in County Galway (Galway City Council, 2007). All cases were residents of County Galway (Pelly, et al., 2007). The public water which supplies County Galway was cited as the main source of the outbreak and *C. hominis* was the causative agent of the outbreak. On average, County Galway reports an average of three or four cases of cryptosporidiosis per month. Travel group members in the investigation spent one day visiting Galway on June 3, 2006, however, the timing of this trip was outside the incubation period for this outbreak.

## Conclusion

Laboratory testing demonstrated that the outbreak originated in Ireland, and that the water at the dinner theater restaurant was the most probable source, but the exact exposure responsible for the cases of illness was not confirmed. Further investigation by the HPSC in Ireland would be necessary to examine a possible cross-contamination of the restaurants' water (public and private water sources) as well as an evaluation of other possible exposures.

The complexities of investigating an outbreak increase when multiple exposures,

public health jurisdictions, and investigative authorities are involved. When working with public health partners, the responsibilities of the investigation often span several jurisdictions. Public health diplomacy was critical in providing justification that environmental health inspections were warranted without imposing on a foreign health system. One of the outbreak investigators had previously lived in Ireland and visited the Killarney region on several occasions, enhancing the team's ability to communicate with colleagues in Ireland. Providing epidemiologic study data to the HPSC health authorities, including the results of genotype

testing, was critical in substantiating that an inspection of the dinner theater restaurant's water source was necessary. Communication, information sharing, and enhanced diplomacy proved essential in an effort to investigate an outbreak across international borders. 🐷

**Acknowledgements:** Eugenia Ngo-Seidel, M.D., M.P.H.; Joann Schulte, D.O., M.P.H.; Julia Gill, Ph.D., M.P.H.; Patricia Ragan, Ph.D., M.P.H., P.A.-C.; Robyn Kay, M.P.H.; H. Spencer Turner, M.D.; Carina Blackmore, D.V.M., Ph.D. (Florida Department of Health); Paul McKeown, M.D. (Health Protection Surveil-

lance Centre, Dublin, Ireland); Margaret B. O'Sullivan, M.D., M.B., M.P.H., F.F.P.H.M.I. (Health Service Executive-Southern, Ireland); Sharon Roy, M.D., M.P.H.; Michael J. Beach, Ph.D. (Centers for Disease Control and Prevention Division of Parasitic Diseases); Centers for Disease Control and Prevention Division of Global Migration and Quarantine in Miami.

**Corresponding Author:** Rebecca A. Lazensky, Florida Epidemic Intelligence Service Fellow, Nassau County Health Department, 30 S. 4th St., Fernandina Beach, FL 32034. E-mail: Becky\_lazensky@doh.state.fl.us.

## REFERENCES

- Centers for Disease Control and Prevention. (n.d., updated August 20, 2007). *Cryptosporidium infection Cryptosporidiosis*. Retrieved August 26, 2007, from <http://www.cdc.gov/crypto/>
- Citizens Information. (n.d., updated June 22, 2007). *Health services—how they are organised*. Retrieved October 25, 2007, from [http://www.citizensinformation.ie/categories/health/how-health-is-organised/how\\_health\\_services\\_are\\_organised/?searchterm=health%20boards%20ireland](http://www.citizensinformation.ie/categories/health/how-health-is-organised/how_health_services_are_organised/?searchterm=health%20boards%20ireland)
- Galway City Council. (2007, August 20). HSE West advises that the Boil Water Notice to the area supplied by the Terryland Water Supply can be lifted with immediate effect. Retrieved August 28, 2007, from <http://www.galwaycity.ie/TopNews/MainBody,3989,en.html>
- Glaberman, S., Moore, J.E., Lowery, C.J., Chalmers, R.M., Sulaiman, I., Elwin, K., Rooney, P.J., Millar, B.C., Dooley, J.S.G., Lal, A.A., & Xiao, L. (2002). Three drinking-water-associated *Cryptosporidiosis* outbreaks, Northern Ireland. *Emerging Infectious Diseases*, 8(6), 631–633.
- Heymann, D.L. (Ed.). (2004). *Control of communicable diseases manual* (18th ed.). Washington, DC: American Public Health Association.
- Juranek, D.D. (1995). Cryptosporidiosis: Sources of infection and guidelines for infection prevention. *Clinical Infectious Diseases*, 21(Suppl.), 57–61.
- Pelly, H., Cormican, M., O'Donovan, D., Chalmers, R., Hanahoe, B., Cloughley, R., McKeown, P., & Corbett-Feeney, G. (2007). A large outbreak of cryptosporidiosis in western Ireland linked to public water supply: A preliminary report. *European Surveillance*, 12(5), 3187. Retrieved August 27, 2007, from <http://www.eurosurveillance.org/ew/2007/070503.asp#3>
- Semenza, J.C., & Nichols, G. (2007). Cryptosporidiosis surveillance and water-borne outbreaks in Europe. *European Surveillance*, 12(5), 711. Retrieved October 25, 2007, from <http://www.euro-surveillance.org/em/v12n05/1205-227.asp>

## THANK YOU FOR SUPPORTING THE NETA/AAS SCHOLARSHIP FUND

**Vickie L. Church, M.P.A., R.E.H.S.**  
San Diego, CA (10/07)

**Welford Roberts, Ph.D., R.E.H.S./R.S., D.A.A.S.**  
South Riding, VA (10/07)

**Wendell A. Moore**  
Bowie, MD (12/07)

**George A. Morris, R.S.**  
Waukesha, WI (1/08)

**Howard M. Stiver, M.P.H.**  
Lebanon, OH (1/08)

**James Speckhart, M.S.**  
Ketchikan, AK (1/08)

**James J. Balsamo, Jr., M.S., M.P.H., M.H.A., R.S.**  
Letairie, LA (03/08)

**L. Bruce Clabaugh, R.S.**  
Englewood, CO (03/08)

**Laurie A. Cotulla, R.S.**  
Lodi, CA (03/08)

**Lisa M. Jones, R.S.**  
Las Vegas, NV (03/08)

**Richard Mitzelfelt**  
Edgewood, NM (03/08)

**Edison E. Newman, R.S.**  
Bradenton, FL (03/08)

**Dick Pantages, R.E.H.S.**  
Fremont, CA (03/08)

**Richard E. Pierce**  
Wilkes Barre, PA (03/08)

**Edward Rau**  
Frederick, MD (03/08)

**Kathy S. Slawson**  
Atlanta, GA (03/08)

**Elizabeth Tennant**  
Seattle, WA (03/08)

**Dr. Leon F. Vinci**  
Olathe, KS (03/08)

**LeGrande G. Beatson, Jr., M.S., R.E.H.S.**  
Lynchburg, VA (04/08)

**Elwin B. Coll, R.S.**  
Ray, MI (04/08)

**Sandra J. Donohue, D.P.A.**  
Fresno, CA (04/08)

**Calvin Waldimar Gillis**  
Boise, ID (04/08)

**Lawrence H. Pierce, R.E.H.S., R.S.**  
Milliani, HI (04/08)

**Douglas E. Turner, R.E.H.S.**  
Ventura, CA (04/08)

**Corwin D. Brown**  
Garden Grove, CA (05/08)

**Michael G. Halko, M.S., R.S., D.A.A.S.**  
Anchorage, AK (05/08)

**Eugene P. Pittz**  
Las Vegas, NV (05/08)

**John E. Schilinger**  
Northridge, CA (05/08)

**Marian B. Balster**  
Arroyo Grande, CA (06/08)

**Vincent J. Radke, M.P.H., R.E.H.S.**  
Atlanta, GA (06/08)

**Frank S. Sedzielarz, R.S.**  
Fridley, MN (06/08)

**John A. Steward, R.E.H.S.**  
Atlanta, GA (06/08)

**Steven M. Breithaupt, R.S.**  
Gallup, NM (07/08)

**Sanford M. Brown, Ph.D.**  
Fresno, CA (07/08)

**Jason Hammond Pride**  
Louisville, TN (07/08)

**John S. Horvath, R.E.H.S.**  
Snellville, GA (07/08)

**Kathy S. Slawson**  
Atlanta, GA (07/08)

**Ronald D. Phillips, R.E.H.S., R.E.M., C.H.S.P., M.P.H.**  
Louisville, TN (07/08)

**Richard Roberts, M.P.H.**  
Grover Beach, CA (09/08)

**John G. Todd, Dr.PH., R.S.**  
Titusville, FL (09/08)

**Underwriters Laboratories, Inc.**  
Northbrook, IL (09/08)